

Submission to the Market Risk Advisory Committee Meeting on Climate-related Financial Risk

There is a growing body of evidence that U.S. financial markets are underestimating the risk of climate change and its related costs when valuing firms. While the U.S. equities markets are reasonably efficient with regard to reflecting financial information (i.e., equity prices tend to reflect financial statement information promptly and without bias), the same cannot be said for information on public companies' exposure to climate risk.

We summarize below our recent research on climate-related financial risk factors that we believe are underpriced by the U.S. equity markets. Our research adds critical, new evidence-derived findings to an expanding and important strand of peer-reviewed academic literature on climate risk in financial markets.

For stock market investors, climate risk must consider both climate-related physical disruptions or damages that can affect the future net cash flows of firms (and climate-related benefits where applicable) as well as the risks that might come to businesses from transitioning to a low carbon emissions economy. The latter risk includes not only future buyer preferences for low carbon energy sources but, also, new regulations or legal liabilities that reduce the profits of producers of higher carbon energy. If these risks are not properly assessed in stock market valuations, they could create the possibility of more systemic problems if unexpected changes in valuations of companies' cash flows were to take place rapidly, instead of over decades which is currently assumed by participants in financial markets.

In the United States, there is a high concentration of energy facilities along vulnerable coastlines. Utilities and energy production businesses have already experienced a loss of cash flows related to water scarcity, and an increasing number of environmental lawsuits raise the possibility that investors could be caught off guard. The rapid unexpected changes in valuations of energy-related firms that have declared bankruptcy such as Peabody Energy and the utility PG&E illustrate this point. Stock market changes for those firms were sudden. The decline in ExxonMobil's stock price when it announced that it would write down the value of its major assets in Canadian oil sands and some natural gas reserves is another case in point.

Any sudden repricing of the shares of climate-affected corporations, were it to take place, could reverberate through the entire financial system. It could amplify climate pricing shocks into the larger corporate and municipal debt markets. This would occur because of uncertainty in mechanisms for the settlement of counterparty obligations when there is price volatility or through minimum capital requirements for banks and other financial institutions as lenders.

Research studies:

- Paul A. Griffin, Amy Myers Jaffe, David H. Lont, and Rosa Dominguez-Faus, "Science and the Stock Market: Investors' Recognition of Unburnable Carbon," *Energy Economics* 52 (2015): 1-12. <https://doi.org/10.1016/j.eneco.2015.08.028>

This paper documents the loss of value experienced by U.S. oil and gas stocks in the immediate aftermath of scientific findings reported in a 2009 article in the prestigious *Nature* journal of science reporting that only a fraction of the world's existing oil, gas, and coal reserves could be emitted if global warming by 2050 were not to exceed 2°C above pre-industrial levels. Our analysis indicates that this publication did influence stock prices, with an average immediate drop of 2% for our sample of the largest U.S. oil and gas companies. Although investors reacted to this first clear indication of a finite carbon budget if global sea level rise and surface temperature rise were to be stabilized, we believe this response was muted compared to scientific data on the possible level of assets that might become unproduceable over time.

Although it is often assumed that return on capital is the predominant metric defining oil and gas company valuations, academic studies also suggest that oil prices, reserve replacement, and reserve size are significant factors in company valuations. Climate change and particularly the global climate accords reached in Paris in 2015 raise the prospect that unproduced oil and gas reserves could depreciate in value over time, which is a climate transition risk not fully reflected in stock values. In decades prior, investors worked on the assumption that reserve values would appreciate over time. Relatedly, perceptions about long-run oil prices have also changed as technology has unleashed a new abundance of unconventional oil and gas resources in the United States, Canada, and internationally. However, technology has also created uncertainty about long-run demand trends, since new technologies could be used to increase energy efficiency and fuel switching in the residential, industrial, and transportation sectors. Such technology risk may also be underpriced by the financial markets.

- Paul A. Griffin, David H. Lont, and Yuan Sun. "The Relevance to Investors of Greenhouse Gas Emission Disclosures", *Contemporary Accounting Research* 34:2 (2017), 1265-1297. <https://doi.org/10.1111/1911-3846.12298>

This study documents that investors care about U.S. companies' greenhouse gas (GHG) emissions and price them as an off-balance sheet liability at the equivalent of about \$80 per ton of CO₂ emissions. Two kinds of evidence support this finding. First, investors act as if they use GHG emissions data disclosed voluntarily through the Carbon Disclosure Project (CDP) to assess the negative effect on company value. Second, investors view estimates of non-disclosed GHG emission amounts as value relevant, suggesting that stock prices reflect GHG information from channels other than CDP disclosure. This paper also concludes that the off-balance sheet liability is equivalent to U.S. equity markets pricing the social cost of carbon at around \$80 per CO₂ ton. Several studies, however, indicate that the optimal social cost of carbon for a smooth transition is much higher and will continue to increase in line with continued delays in transitioning to a

zero-emissions or low-carbon economy. These results are consistent with climate transition risk underpricing.

- Paul A. Griffin and Amy Myers Jaffe, "Are Fossil Fuel Firms Informing Investors Well Enough About the Risks of Climate Change?," *Journal of Energy & Natural Resources Law* 36 (2018): 381-410. <https://doi.org/10.1080/02646811.2018.1502240>

This paper focuses on the securities' litigation risk faced by fossil fuel firms based on allegations of insufficient disclosure of climate risk in published financial statements and allegations of omissions and misrepresentations in those financial statements based on material information known privately to managers but not disclosed promptly to outsiders. Our analysis suggests that the physical risks of future environmental accidents and the possible risk of legal liability are not fully reflected in today's equity market prices. As an initial policy to correct for this asymmetry in climate risk disclosure, we propose that the Securities & Exchange Commission (SEC) initiate a voluntary disclosure program (similar to the program prescribed under the Foreign Corrupt Practices Act) for climate risk information and apply this initially for three to five years to a small set of the largest public companies based on market capitalization. A pilot disclosure program of this kind would provide valuable evidence as a basis for a more permanent program for climate risk disclosure applied to all registrants.

- Paul A. Griffin, Thaddeus Neururer, and Estelle Y. Sun, "Environmental Performance and Analyst Information Processing Costs," *Journal of Corporate Finance* (2018). <https://doi.org/10.1016/j.jcorpfin.2018.08.008>

In this study, we show that the sheer volume of climate risk information can limit the incorporation of material information into the pricing of affected stock prices because the large nature of the information and the difficulty to translate that information into performance related metrics imposes high information processing costs on analysts. We show that analysts reduce coverage and delay updating their earnings forecasts in response. As a result, prices are less efficient despite the existence of more climate-related information. Analysts have also been shown to be slow in updating their different expectations metrics (e.g., sales and earnings forecasts) in response to climate risk related to extreme weather events, water scarcity and other kinds of risks that are already emerging. Overall, our study implies that while much climate risk information is available, constraints and barriers relating to information processing can prevent timely reflection of that information in market prices. Regulations requiring additional disclosure of climate information should not ignore these constraints and frictions.

- Paul A. Griffin, "U.S. Climate Risk and Financial Markets: Is Climate Risk Fully Discounted?" Presented at the Council on Foreign Relations Workshop on Climate Risk Impacts on the Energy System: Examining the Financial, Security and Technological Dimensions, New York, March 18-19, 2019. For a summary of the workshop's findings and conclusions, see <https://www.cfr.org/report/climate-risk-impacts-energy-system>.

This research suggests that stock market investors price the social cost of carbon at around \$80 per CO₂ ton. While this market-implied price might seem high compared to some recent proposals for a carbon tax in the United States, we stress that our \$80 estimate is what investors appear to be applying to the cost of emissions produced by U.S. companies (not what is politically expedient). Some scientific studies suggest a higher price of carbon might be needed, especially if there is continued delay in transitioning to a zero-emissions or low-carbon economy and a more rapid pace of transition is required. While some prominent investment firms have acknowledged an investable opportunity may exist to account for carbon-related repricing of stock values, their actions do not appear to have been sufficient to induce counterparty reactions in other markets (e.g., shorting markets) through hedging or arbitrage.

- Paul A. Griffin, David H. Lont, and Martien Lubberink. "Extreme High Surface Temperature Events and Equity-Related Physical Climate Risk." Under second-round revision at the *Weather and Climate Extremes*, a scientific journal on the topic.

This paper provides evidence that U.S. equity markets are underpricing physical climate risk because investors fail to recognize sufficiently the impact that extreme weather events have on the future cash flows of firms based on the locations of their businesses, assets or sales. Firms with immovable assets in locations with high extreme weather risk are especially prone to physical climate risk underpricing. Based on NOAA datasets on the frequency, duration, and cost of extreme heat events, this paper finds a reduction in risk-adjusted stock return and an increase in stock return volatility immediately following these extreme events, consistent with extreme weather risk underpricing.

The results in our "extreme weather" paper are fully consistent with "climate change causing more volatile, frequent, and extreme events", ... "which poses financial risk to the stability of the financial system" (Rostin Behnam, New York Times, June 11, 2019).

<https://www.nytimes.com/2019/06/11/climate/climate-financial-market-risk.html>

The SEC presently offers no clear guidance on the disclosure in financial statements of extreme weather risk as a physical climate risk factor relevant to financial asset pricing. Because improved climate risk disclosure can help reduce climate risk underpricing in financial markets, which prevents market failures from the sudden repricing of company stocks, regulators should also do more to ensure accurate and timely disclosure of extreme weather risk.

Thank you for the opportunity to inform the Committee.

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